NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

SPECIAL REPORT #66-A

SUPPLEMENT TO

"A STUDY OF TRANSPARENT PLASTICS FOR USE ON AIRCRAFT"

By Benjamin M. Axilrod and Gordon M. Kline
National Bureau of Standards

August 1937

SUPPLEMENT TO

"A STUDY OF TRANSPARENT PLASTICS FOR USE ON AIRCRAFT"*

By Benjamin M. Axilrod and Gordon M. Kline

Experimental work on the bursting strengths of transparent plastics used for windshields on aircraft was described on pages 22 and 23 of an N.A.C.A. Confidential Memorandum issued May 1937 and entitled "A Study of Transparent Plastics for Use on Aircraft," by Benjamin M. Axilrod and Gordon M. Kline. Further data on the bursting strengths of plastics, particularly at low temperatures, have been obtained. Table I of this supplement includes the values reported in table XXIII of the above-mentioned Memorandum and the additional values obtained at approximately 25° C. for three samples of acrylate resin. Table II presents the data obtained for the bursting strength when one surface of the plastic was cooled to approximately -35° C. The cooling was accomplished by application of a mixture of dry ice and an organic liquid to the outer surface and allowing the mixture to remain in contact with the plastic for five minutes before forcing water at room temperature against the opposite surface. When kerosene or ethylene glycol was used as the cooling medium, the bursting strengths of the cellulose acetate and acrylate plastics were about the same as the values obtained at room temperature. Ethylene dichloride at -35° C. had a deleterious effect on both cellulose acetate and acrylate resin and gave bursting strengths much lower than were observed with kerosene and ethylene glycol. Thus, one sample of an acrylate type of resin 0.2 inch thick failed at 100-117 pounds per square inch at room temperature, at 108-126 pounds per square inch at -35° C. when cooled with the kerosene-dry ice mixture, and at 64 pounds per square inch when ethylene dichloride was used as the cooling medium. Examination of the latter specimen revealed minute crazing of the cooled surface. Likewise, cellulose acetate approximately 0.1 inch thick, which failed at 350 pounds per square inch with the kerosene-dry ice mixture, burst at 167 pounds per square inch when tested under similar conditions except that ethylene dichloride was used in cooling the specimen.

---

*Issued as a Confidential Memorandum, May 1937.

TABLE I

Bursting Tests on Transparent Plastics

at Approximately 25° C.

Material	Sample number	Thickness	Maximum pressure	Type of failure
		mils	lb./sq.in.	
A. Without rubber gaskets				
Cellulose acetate	B2	93	295	Shear
" "	B3	65	200	Lateral tension
" "	C1	57	165	Shear at edge
" "	C3	125	400	Lateral tension
Cellulose nitrate	W1	93	375	Shear
Acrylate resin	K5	70	26	Shear
" "	K10	98	46	Shear
Vinyl acetal resin	N1	49	100	Pinhole developed between center and edge
" " "	N1	49	115	Shear
B. With rubber gaskets				
Cellulose acetate	C1	56	190	Lateral tension
" "	C3	125	430	Lateral tension
" "	B2	93	340	Shear at edge (slipped in grips)
Cellulose nitrate	W1	93	380	Lateral tension
Acrylate resin	K10	97	44	Shear in grips
" "	K11	65	33	Shear at edge
" "	K11	73	32	" " "
" "	K12	97	45	" " "
" "	K12	98	45	" " "
" "	K13	202	117	" " "
" "	K13	185	100	" " "

TABLE II

Bursting Tests on Transparent Plastics Cooled to Approximately -35° C. on Outer Surface

Material	Sample number	Thickness	Cooling liquid applied on top surface	Maximum pressure	Type of failure
		mils		lb/sq. in.	
A. Without rubber gaskets					
Cellulose acetate	B14	107	Ethylene dichloride	167	Lateral tension
" "	B14	107	Kerosene	350	Shear and lateral tension
" "	C6	127	Kerosene	370	Lateral tension
" "	C6	127	Ethylene glycol	420	Shear and lateral tension
Acrylate resin	K5	73	Ethylene dichloride	*	Shear; surface crazed
" "	K11	65	Kerosene	33	Shear
B. With rubber gaskets					
Cellulose acetate	B14	107	Ethylene dichloride	180	Shear at edge
Acrylate resin	K7	231	Kerosene	168	Shear
" "	K7	232	Ethylene glycol	142	"
" "	K12	97	Kerosene	51	"
" "	K12	97	Kerosene	58	"
" "	K13	199	Kerosene	126	"
" "	K13	201	Kerosene	108	"
" "	K13	192	Ethylene dichloride	64	Shear and radial failure; surface crazed

*Failed before appreciable load could be applied.